Development of a Portable ADS-B Avionics Transmissions Evaluation Tool

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2006 Integrated CNS Technologies Conference & Workshop
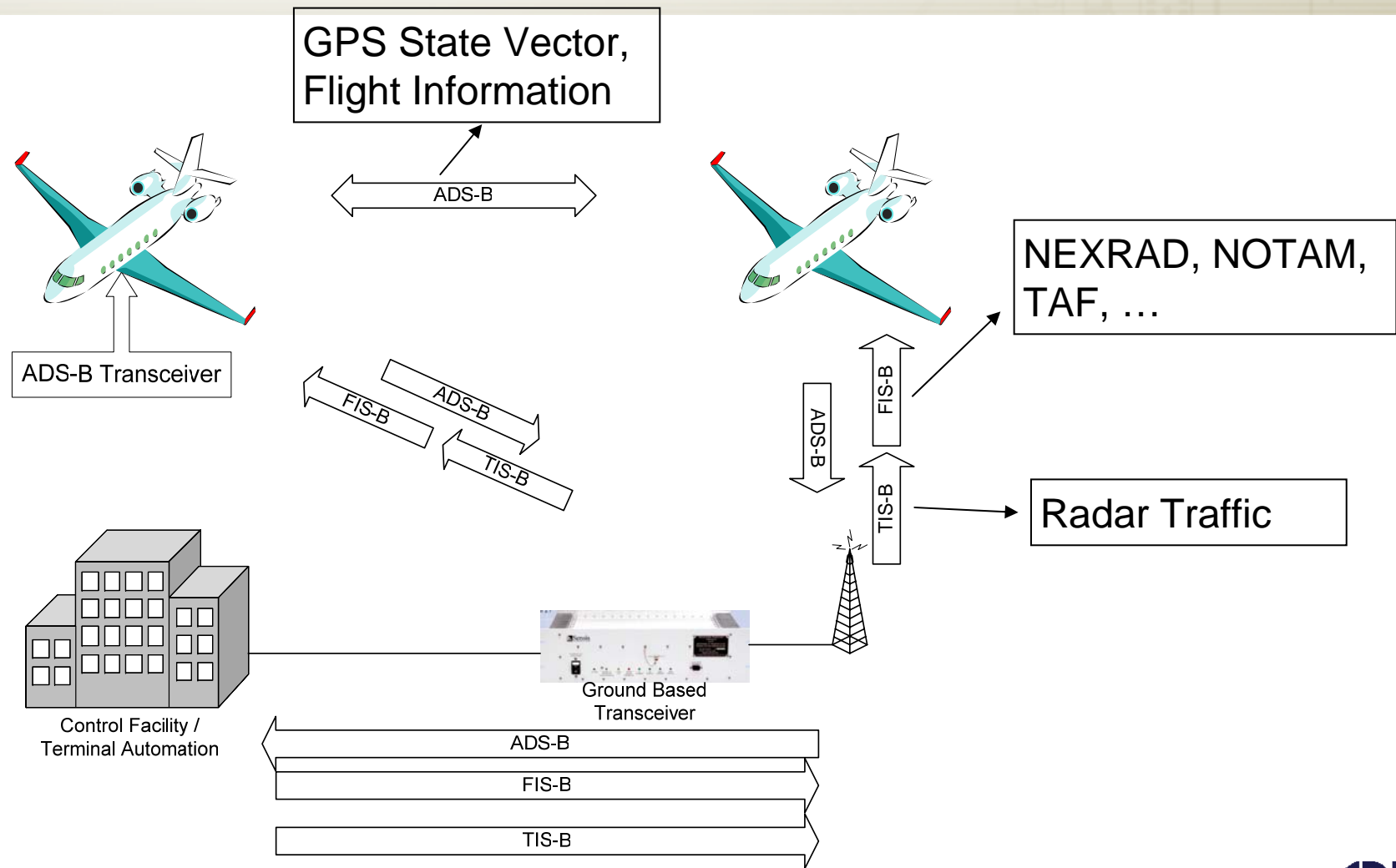*April 30 - May 3, 2006*
Baltimore, Maryland

Outline

1. What is Automatic Dependent Surveillance Broadcast (ADS-B)?

2. ADS-B Equipage

3. Operational Uses

4. Need for ADS-B Equipment Testing

5. Hardware of the Avionics Test Tool

6. Test Functions

7. Future Work

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ADS-B System Overview

GPS State Vector, Flight Information

ADS-B

ADS-B Transceiver

FIS-B

ADS-B

TIS-B

NEXRAD, NOTAM, TAF, …

FIS-B

ADS-B

TIS-B

Radar Traffic

Control Facility / Terminal Automation

Ground Based Transceiver

ADS-B

FIS-B

TIS-B

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ADS-B Equipage

Universal Access Transceiver (UAT)

- **General aviation traffic in Alaska,**
- **Training aircraft of Embry Riddle Aeronautical University in Prescott, AZ and Daytona, FL**
- **MD State Police, US Park Police**

1090 Extended Squitter (1090ES)

- **Cargo transports of the United Parcel Service (UPS)**
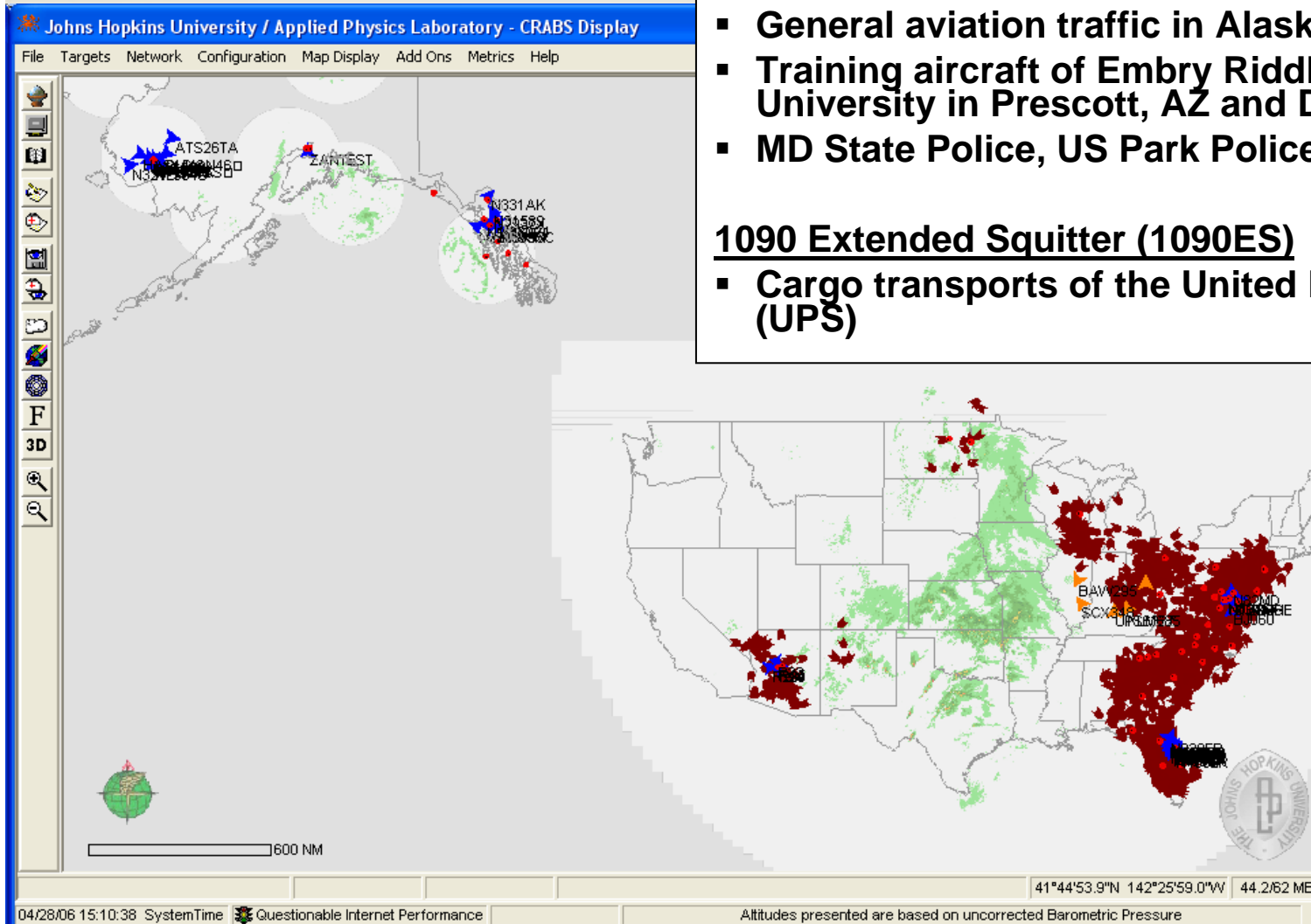
Operational Uses

- **Automation Systems -** The FAA is completing initial testing for ADS-B integration into various en-route and terminal automation systems.

- **Fleet Monitoring** - The Maryland State Police, Embry Riddle Aeronautical University, and various other entities are utilizing ADS-B to passively monitor their fleets.

- **Situational Awareness** - air to air communication is being utilized for enhanced situational awareness. UPS has equipped the majority of their fleet with 1090ES ADS-B transceivers and cockpit traffic displays

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Need for ADS-B Equipment Testing

- There are no available tools to independently verify valid messages are being transmitted

- The current post-installation procedures for the UAT include several quick checks. These include:
  - System self-test
  - GPS interference check.

- These checks are not intended to verify that a MOPS compliant message is being transmitted and that the proper user-defined parameters are configured correctly

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Testing Approach

There are 2 general approaches:

1. View ADS-B reports from one or more Ground Broadcast Transceivers (GBT)

- Valuable when evaluating an entire fleet remotely
- Test functions are limited to information available in a ADS-B CAT33 report

2. View ADS-B messages output directly from a local avionics receiver

- More complex, requiring additional hardware
- Test Conductor can visually observe the aircraft
- Additional cross checks are available by observing the aircraft and communication with the Pilot

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Hardware Overview

All COTS hardware
(except wiring
harnesses and
antenna connections)

Serial Connections
to PC

DC and AC
power source
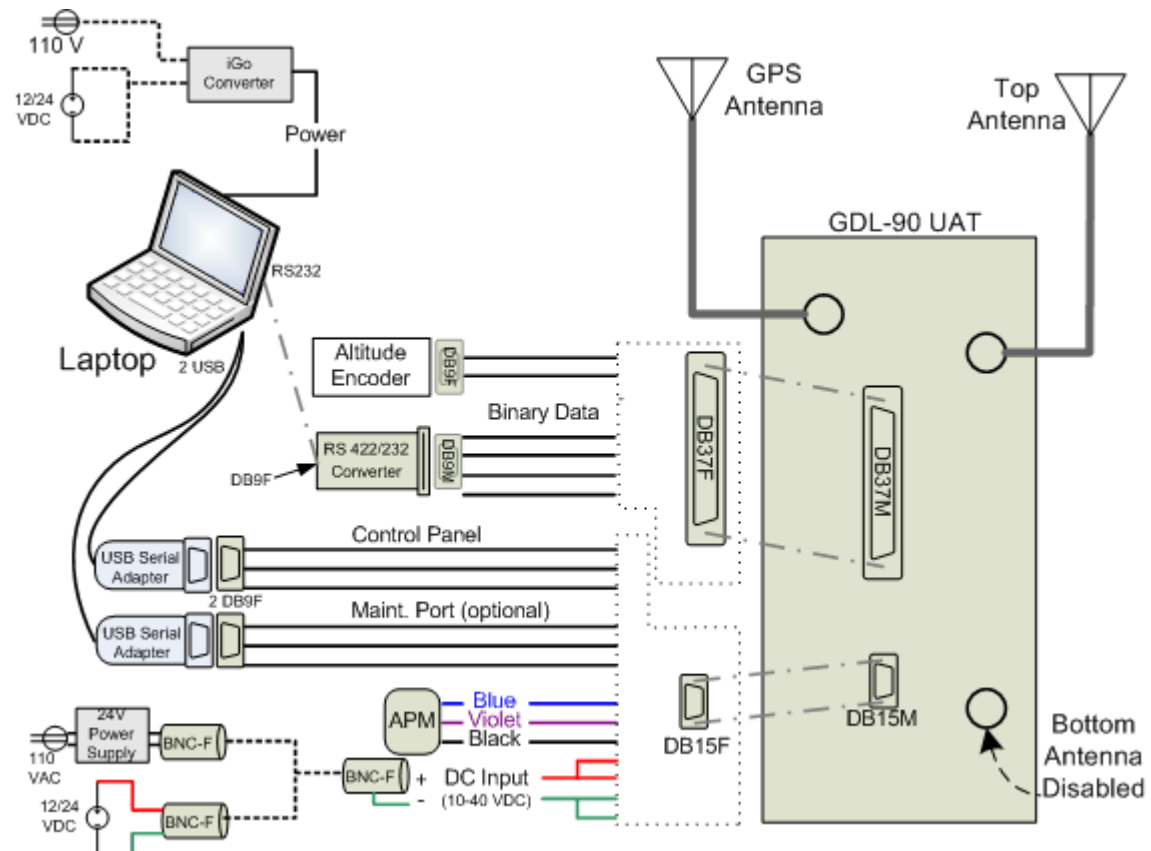
Compact Local Avionics Monitor (CLAM) Implementation

- **Operation from travel case**
- **Magnetic mount 978Mhz and GPS antennas**

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Test Functions within CLAM

- **Successful Decoding** – indicates requirements governing message formats and transmission subsystems are working properly

- **Message Scheduling**
  - Verify that the UAT is transmitting the various message payloads
  - Verify the proper order of messages are transmitted
  - Failures may indicate either the top or bottom antenna is non-functional

- **Data Quality**
  - These checks monitor the reported: position integrity, accuracy, and UTC coupling fields
  - The UAT own-ship data is used to cross check the quality of ADS-B data. (i.e. reported GPS position and barometric altitude)

- **Data Validity**
  - Verify the UAT messages are populated with the correct aircraft specific parameters
  - Parameters include aircraft length and width, emitter type, and Air/Ground thresholds

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Test Functions Requiring Cooperation with Pilot

- **Verify 24-bit Address** - Check Tail Number against the reported 24-bit address using the FAA's Aircraft Registry.

- **Ident Verification** - Activate the "Ident" feature and acknowledge Ident is received for 20 seconds, per DO-282A.

- **GPS Interference**
  - Key the microphone successively at varying frequencies (as in UAT Installation Manual) and monitor the GPS integrity
  - Enable all aircraft instruments

- **Verify Air/Ground State** - Observe the reported Air/Ground state during departure.
  - Depending on the Aircraft weight there may be specific criteria specifying the speed and altitude at which the UAT must indicate the "Airborne" state

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Software User Interface

- **ADS-B data output**

- **User selects source aircraft**

- **Local traffic display**

- **Health Status of serial connection**

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Future Work

Near Term:

- Complete user interface development
- Validation Tests with Pilots and Maintenance Personnel

Pipe Dreams:

- Compliance with "Software Considerations in Airborne Systems and Equipment Certification", DO-178b
- Integrate a 1090 Mhz Extended Squitter Receiver
- Spectrum analysis

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